UNIFORM COUPLING

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates in general to uniform couplings, such as a coupling applied to a propeller shaft and the like, for wheeled motor vehicles, and more particularly to the uniform couplings of a type that can be easily assembled without inducing undesirable blocking of an air bleeding passage that provides a fluid communication between the inside of the coupling and the outside of the same.

2. Description of Related Art

In order to clarify the task of the present invention, one known uniform coupling will be briefly described in the following, which is disclosed in Japanese Utility Model Provisional Publication (Jikkaisho) 61-117921.

The uniform coupling of the publication generally comprises a torque transmitting unit through which two shafts are connected. A boot extends between the two shafts while covering the torque transmitting unit. For connection with the shafts, each axial end of the boot has a connecting mouth. The interior of the boot is filled with a grease for lubricating elements of the torque transmitting unit.

For releasing an undesired pressure inevitably produced in the boot due to thermal expansion of the interior of the boot, there is provided an air bleeding passage between one of the shafts and the corresponding connecting mouth of the boot. For protecting the air bleeding passage from sludge, water and the like, a boot cover is connected to the shaft in a manner to cover the connecting mouth of the boot while keeping a certain clearance therebetween.

SUMMARY OF THE INVENTION

However, in the uniform coupling of the above-mentioned

publication, it is difficult or at least troublesome to assemble the coupling without inducing blocking of the air bleeding passage. That is, under assembling of the coupling, it tends to occur that the boot cover is deformed toward the connecting mouth of the boot. If the boot cover is brought into contact with the connecting mouth of the boot, the air bleeding passage is blocked and thus the pressure releasing function of the passage becomes poor.

It is therefore an object of the present invention to provide a uniform coupling which is free of the above-mentioned drawback.

That is, according to the present invention, there is provided a uniform coupling which can be easily assembled without inducing an undesirable blocking of an air bleeding passage that provides fluid communication between the interior of the coupling and the outside of the same.

According to a first aspect of the present invention, there is provided a uniform coupling which comprises a torque transmitting unit; first and second shafts that are connected through the torque transmitting unit; a boot covering the torque transmitting unit and having a first end connected to the first shaft and a second end connected to the second shaft, the second end being formed into a cylindrical wall that is tightly disposed on a cylindrical portion of the second shaft and has an axially leading end; a boot cover disposed on the cylindrical portion of the second shaft to cover the cylindrical wall leaving an annular space therebetween, the boot cover having an inside end surface that contacts the axially leading end of the cylindrical wall; and an air bleeding passage that communicates the inside of the boot with the outside of the same, the air bleeding passage including a first passage that is at least one groove formed in an inner surface of the cylindrical wall and a second passage that is defined between the axially leading end

of the cylindrical wall and the inside end surface of the boot cover.

According to a second aspect of the present invention, there is provided a uniform coupling which comprises a torque transmitting unit; first and second shafts that are connected through the torque transmitting unit; an elastic boot covering the torque transmitting unit and having a first end connected to the first shaft and a second end connected to the second shaft, the second end being formed into a cylindrical wall that is tightly disposed on a cylindrical portion of the second shaft and has an axially leading end; an elastic boot cover disposed on the cylindrical portion of the second shaft to cover the cylindrical wall leaving an annular space therebetween, the boot cover having an inside end surface that contacts the axially leading end of the cylindrical wall; and an air bleeding passage that communicates the inside of the boot with the outside of the same, the air bleeding passage including at least one axially extending groove formed in an inner surface of the cylindrical wall and at least one radially extending groove formed in the axially leading end of the cylindrical wall.

According to a third aspect of the present invention, there is provided a uniform coupling which comprises a torque transmitting unit; first and second shafts that are connected through the torque transmitting unit; an elastic boot covering the torque transmitting unit and having a first end connected to the first shaft and a second end connected to the second shaft, the second end being formed into a cylindrical wall that is tightly disposed on a cylindrical portion of the second shaft and has an axially leading end; an elastic boot cover disposed on the cylindrical portion of the second shaft to cover the cylindrical wall leaving an annular space therebetween, the boot cover having an inside end surface that contacts the axially leading end of the cylindrical wall; and an air bleeding passage that communicates

the inside of the boot with the outside of the same, the air bleeding passage including at least one axially extending groove that is formed in an inner surface of the cylindrical wall and a clearance that is defined between the axially leading end and the inside end surface, the inside end surface being formed with projections that contact the axially leading end to provide the clearance.

BRIEF DESCRIPTION OF THE DRAWINGS

Other objects and advantages of the present invention will become apparent from the following description when taken in conjunction with the accompanying drawings, in which:

Fig. 1 is a sectional view of an essential portion of a uniform coupling, which is a first embodiment of the present invention;

Fig. 2 is a partially sectional view of the uniform coupling of the first embodiment of the present invention;

Fig. 3 is a sectional view taken along the line A-A of Fig. 1 with some parts removed;

Fig. 4 is a perspective view of an essential portion of the uniform coupling of the first embodiment;

Fig. 5 is a sectional view of an essential portion of the uniform coupling of the first embodiment in process of assembly;

Fig. 6 is a view similar to Fig. 1, but showing a second embodiment of the present invention;

Fig. 7 is a sectional view taken along the line B-B of Fig. 6 with some parts removed;

Fig. 8 is a sectional view taken along the line C-C of Fig. 6 with some parts removed; and

Fig. 9 is a perspective view of a boot cover employed in the second embodiment.

DETAILED DESCRIPTION OF THE EMBODIMENTS

In the following, two embodiments 100 and 200 of the present invention will be described in detail with reference to the

accompanying drawings.

For ease of description, various directional terms, such as, right, left, upper, lower, rightward and the like are used in the following. However, such terms are to be understood with respect to only a drawing or drawings on which a corresponding part or portion is shown.

Referring to Figs. 1 to 5, there is shown a uniform coupling 100 which is a first embodiment of the present invention. It is to be noted that uniform coupling 100 shown in the drawings is of a type particularly used for a propeller shaft of a wheeled motor vehicle.

In Fig. 2, there is shown a propeller shaft 1 to which uniform coupling 100 of the first embodiment is practically applied.

Propeller shaft 1 shown comprises a drive shaft (or first shaft) 2 that is connected to an output shaft of a transmission (not shown), a driven shaft (or second shaft) 3 that is connected to drive road wheels (not shown) through a differential (not shown), and the uniform coupling 100 through which the drive and driven shafts 2 and 3 are connected. Denoted by numeral 5 is a center bearing through which an inward end of drive shaft 2 is rotatably supported by a vehicle body (not shown).

As is seen from Fig. 1, drive shaft 2 is integrally formed at a right end thereof with a tubular portion 6 that forms an outer race of uniform coupling 100. Driven shaft 3 is integrally formed at a left end with a cylindrical stub portion 7 that is concentrically received in tubular portion 6 of drive shaft 2 as shown.

Uniform coupling 100 comprises the outer race that is provided by tubular portion 6, an annular inner race 12 that is provided on a left end of cylindrical stub portion 7, a plurality of torque transmission balls 13 that are rotatably disposed between inner race 12 and the outer race (viz., an inner wall of tubular

portion 6), and an annular cage 14 that rotatably holds the balls 13. With this arrangement, tubular portion 6 and stub portion 7 are connected allowing mutual slanting movement therebetween, like a universal joint. That is, outer race 6, inner race 12, balls 13 and annular cage 14 constitute a torque transmitting unit.

Between tubular portion 6 of drive shaft 2 and stub portion 7 of driven shaft 3, there extends a rubber boot 8, so that the interior of tubular portion 6 is sealed by boot 8. The interior of tubular portion 6 is filled with a grease for lubricating inner race 12, outer race 6, torque transmission balls 13 and annular cage 14.

As is shown in Fig. 1, a cylindrical boot holder 9 of metal is fixed to the open end of the tubular portion 6 of drive shaft 2. Boot holder 9 has a caulked leading end 9a by which one end of boot 8 is pinched or held, as shown.

As shown, boot 8 comprises a conical inner portion 8a, a conical outer portion 8b and an annular middle portion 8c through which conical inner and outer portions 8a and 8b are integrally connected. Thus, boot 8 has a generally W-shaped cross section when sectioned along a longitudinal axis thereof, as shown.

An outer periphery of conical outer portion 8b is pinched by caulked end 9a of boot holder 9, and a smaller diameter end of boot 8 constitutes a cylindrical wall 10 that is tightly disposed on cylindrical stub portion 7 of driven shaft 3 by means of a clamping ring 11.

As is seen from Figs. 1, 3 and 4, cylindrical wall 10 of boot 8 is formed at its inner cylindrical surface with two parallel grooves (or first passage) 15 that extend axially. Furthermore, cylindrical wall 10 is formed at its annular flat front end (or axially leading end) 10A with two radially extending grooves (or second passage) 16 that are connected to terminal ends of the axially extending parallel grooves 15. As will become apparent

hereinafter, these grooves 15 and 16 constitute part of an air bleeding passage "ABP" through which the pressure inevitably produced in tubular portion 6 can be released to the outside of coupling 100.

As is seen from Fig. 1, a cylindrical rubber boot cover 17 is disposed on cylindrical stub portion 7 of driven shaft 3, which covers cylindrical wall 10 of boot 8 having a given annular space "S" left therebetween.

That is, boot cover 17 comprises a cylindrical base portion 17a that is tightly disposed on stub portion 7, a cylindrical cover portion 17b that is raised radially outward from a left end of base portion 17a to cover cylindrical wall 10 having the given annular space "S" kept therebetween, and a leading lip portion 17c that is bent radially inward from a left end of cover portion 17b and contacts the conical inner portion 8a of boot 8, as shown.

Cylindrical base portion 17a of boot cover is formed on its inner surface with an annular projection 17a' that is intimately thrust in an annular groove 19 formed in cylindrical stub portion 7 of driven shaft 3.

Designated by 17d is an inside end surface of cylindrical base portion 17a, that contacts annular flat front end 10A of cylindrical wall 10 of boot 8.

As is seen from Fig. 1, leading lip portion 17c of boot cover 17 is formed at its inner surface with a plurality of grooves 18 that extend axially, which constitute part of the air bleeding passage "ABP".

Thus, upon assembly of uniform coupling 100, there is produced the air bleeding passage "ABP" that includes the axially extending parallel grooves 15, the radially extending grooves 16, the given annular space "S" and the grooves 18. Through the air bleeding passage "ABP" thus produced, an increased pressure produced in tubular portion 6 in which the essential elements 12, 13 and 14 are installed can be released to the open air.

Fig. 5 shows one step of assembling coupling 100. That is, for simplifying the steps of assembly, boot 8 and boot cover 17 are coupled previously and these thus coupled are temporarily mounted on cylindrical stub portion 7 of driven shaft 3 having annular projection 17a' put in annular groove 19 of stub portion 7, as is understood from Fig. 1. Then, as is seen from Fig. 5, only boot cover 17 is displaced rightward as in indicated by an arrow "X" to such a position that the outer surface of cylindrical wall 10 of boot 8 is exposed to the outside. Then, clamping ring 11 is disposed about the cylindrical wall 10 to tightly fix boot 8 to stub portion 7 of driven shaft 3, and then, boot cover 17 is returned or moved to its original position.

As is seen from Fig. 1, upon returning of boot cover 17 to its original position, inside end surface 17d of boot cover 17 is brought into contact with annular flat front end 10A of cylindrical wall 10 of boot 8. However, provision of radially extending grooves 16 formed in the front end 10A keeps the open condition of the air bleeding passage "ABP".

Referring to Figs. 6 to 9, there is shown a uniform coupling 200 which is a second embodiment of the present invention.

Since coupling 200 of this embodiment is similar to coupling 100 of the above-mentioned first embodiment, only parts or portions different from those of the first embodiment will be described in detail in the following, and such similar parts or portions are denoted by the same numerals.

That is, in the second embodiment 200, there is no groove that corresponds to the radially extending grooves 16 used in the first embodiment 100. That is, in place of such grooves 16, the following measure is employed for establishing the open condition of air bleeding passage "ABP".

As is seen from Fig. 7, like the above-mentioned first embodiment 100, cylindrical wall 10 of boot 8 is formed at its inner wall with two parallel grooves (or first passage) 15 that

extend radially. However, annular flat front end (or axially leading end) 10A of cylindrical wall 10 has no radially extending grooves.

Instead, as is seen from Figs. 8 and 9, inside end surface 17d of boot cover 17 is formed with equally spaced four projections 20 whose top surfaces are in contact with annular flat front end 10A of cylindrical wall 10.

Accordingly, as is understood from Fig. 6, upon assembly of coupling 200, there are defined four clearances (or second passage) 21 between inside end surface 17d and annular flat front end 10A, through which two parallel grooves 15 and the given annular space "S" are fluidly communicated. Thus, also in the second embodiment 200, the air bleeding passage "ABP" is established, that includes the axially extending parallel grooves (or first passage) 15, the four clearances (or second passage) 21, the given annular space "S" and the grooves 18.

In the second embodiment 200, the fluid communication means between two parallel grooves 15 and the given annular space "S" is provided substantially by boot cover 17 that is not affected by a clamping force produced by clamping ring 11. Thus, the open condition of air bleeding passage "ABP" is much assuredly achieved.

If desired, in the second embodiment 200, in place of the projections 20, inside end surface 17d of boot cover 17 may be formed with radially extending grooves through which two parallel grooves 15 and the given annular space "S" is established.

Although the foregoing description is directed uniform couplings 100 and 200 that are applied the propeller shaft 1, the member to which the coupling of the invention is applied may be any shaft other than propeller shaft 1.

The entire contents of Japanese Patent Application 2003-36906 filed February 14, 2003 are incorporated herein by

reference.

Although the invention has been described above with reference to the embodiments of the invention, the invention is not limited to such embodiments as described above. Various modifications and variations of such embodiments may be carried out by those skilled in the art, in light of the above description.